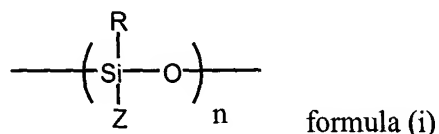


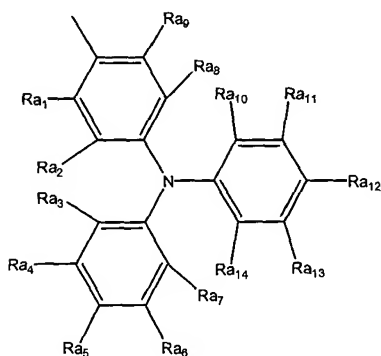
# WHAT IS CLAIMED IS:

1. A composition comprising a polymer represented by the following formula (i), wherein the composition exhibits photorefractive ability:

5



wherein R is selected from the group consisting of a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons; n is an integer of 10 to 10,000; Z is a group which contains at least a tri-aromatic amine moiety shown in the structure (ii):



structure (ii)

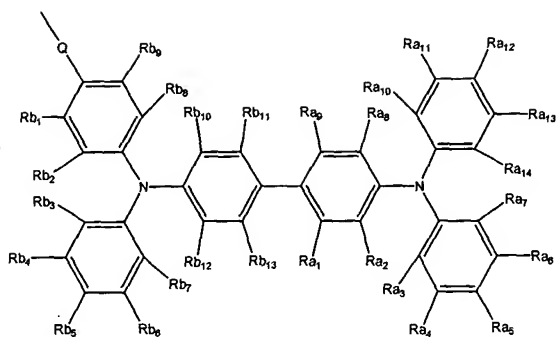
wherein Ra<sub>1</sub>-Ra<sub>14</sub> are independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons.

15

2. The composition of Claim 1,

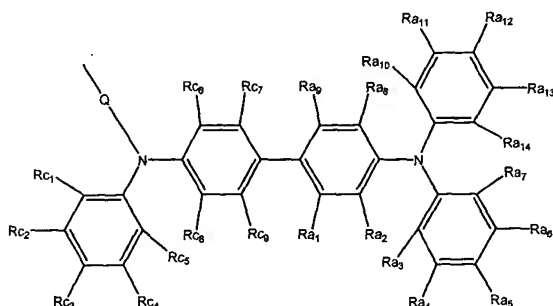
wherein said Z in said formula (i) is represented by a structure selected from the group consisting of the structures (iii) and (iv):

20 Structure (iii)



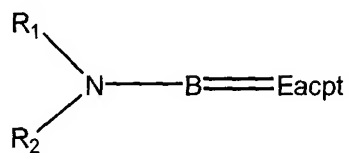
wherein Q represents an alkylene group, with or without a hetero atom; and Rb<sub>1</sub>-Rb<sub>13</sub> and Ra<sub>1</sub>-Ra<sub>14</sub> are independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons; and

Structure (iv)



wherein Q represents an alkylene group, with or without a hetero atom; and Rc<sub>1</sub>-Rc<sub>9</sub> and Ra<sub>1</sub>-Ra<sub>14</sub> are independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons.

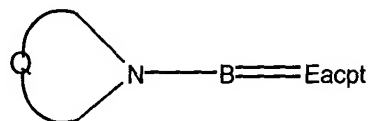
3. The composition of Claim 1, further comprising at least one chromophore selected from the group consisting of the following formulae (v), (vi), (vii), and (viii):



formula (v)

wherein R<sub>1</sub> and R<sub>2</sub> are selected from the group consisting of a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with

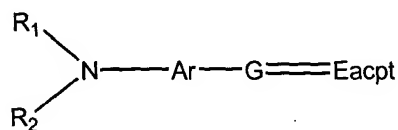
up to 10 carbons;  $R_1$  and  $R_2$  can be either same or different; B is a group having a bridge of -conjugated bond; and Eacpt is an electron acceptor group;



formula (vi)

5

wherein Q represents an alkylene group, with or without a hetero atom; B is a group having a bridge of -conjugated bond; and Eacpt is an electron acceptor group;

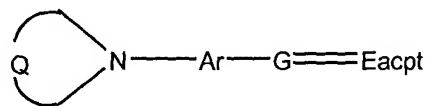


formula (vii)

10

wherein Ar represents an aromatic group, with or without a hetero atom;  $R_1$  and  $R_2$  are selected from the group consisting of a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons;  $R_1$  and  $R_2$  can be either same or different; G is a group having a bridge of -conjugated bond; and Eacpt is an electron acceptor group;

15

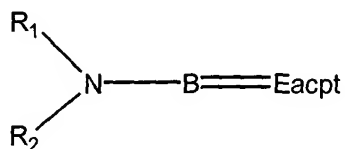


formula (viii)

wherein Ar represents an aromatic group, with or without a hetero atom; G is a group having a bridge of -conjugated bond; Eacpt is an electron acceptor group; and Q represents an alkylene group, with or without a hetero atom.

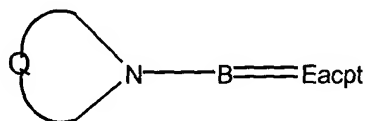
20

4. The composition of Claim 2, further comprising at least one chromophore selected from the group consisting of the following formulae (v), (vi), (vii), and (viii):



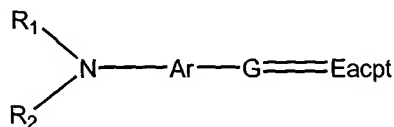
formula (v)

wherein  $R_1$  and  $R_2$  are selected from the group consisting of a linear alkyl group with up to 10 carbons, a branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons;  $R_1$  and  $R_2$  can be either same or different; B is a group having a bridge of -  
 5 conjugated bond; and Eacpt is an electron acceptor group;



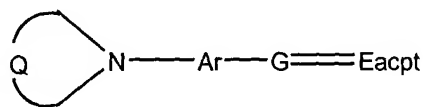
formula (vi)

wherein Q represents an alkylene group, with or without a hetero atom; B is a group  
 10 having a bridge of -conjugated bond; and Eacpt is an electron acceptor group;



formula (vii)

wherein Ar represents an aromatic group, with or without a hetero atom;  $R_1$  and  $R_2$   
 are selected from the group consisting of a linear alkyl group with up to 10 carbons, a  
 15 branched alkyl group with up to 10 carbons, and an aromatic group with up to 10 carbons;  $R_1$   
 and  $R_2$  can be either same or different; G is a group having a bridge of -conjugated bond; and  
 Eacpt is an electron acceptor group;



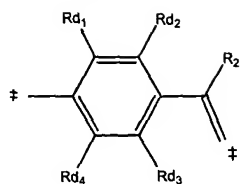
formula (viii)

20 wherein Ar represents an aromatic group, with or without a hetero atom; G is a group  
 having a bridge of -conjugated bond; Eacpt is an electron acceptor group; and Q represents an  
 alkylene group, with or without a hetero atom.

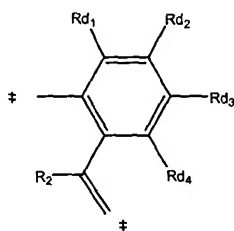
5. The composition of Claim 3, wherein said B in said formula (v) is a group  
 selected from the group consisting of the structures (ix), (x) and (xi);

25 wherein the structures (ix), (x) and (xi) are:

Structure (ix)



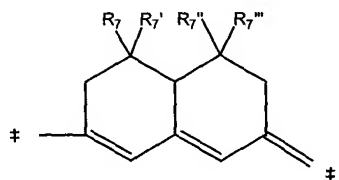
Structure (x)



5

wherein, in the both structures (ix) and (x), Rd<sub>1</sub>-Rd<sub>4</sub> are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons; R<sub>2</sub> is selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

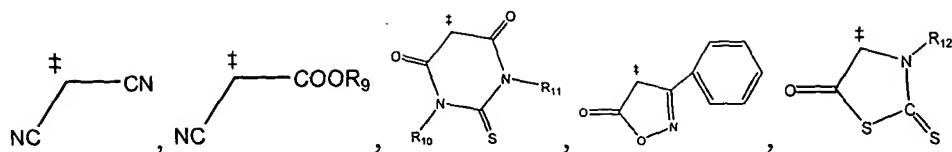
Structure (xi)



15

wherein R<sub>7</sub>, R<sub>7</sub>', R<sub>7</sub>'', and R<sub>7</sub>'''' represent each independently a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

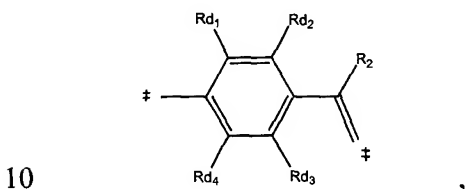
wherein said Eacpt in said formula (v) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



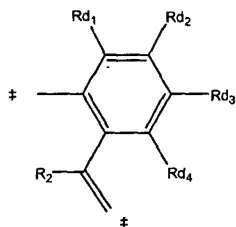
wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

- 5            6.        The composition of Claim 4, wherein said B in said formula (v) is a group selected from the group consisting of the structures (ix), (x) and (xi);  
                  wherein the structures (ix), (x) and (xi) are:

Structure (ix)

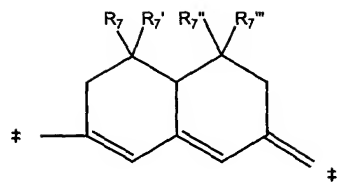


Structure (x)



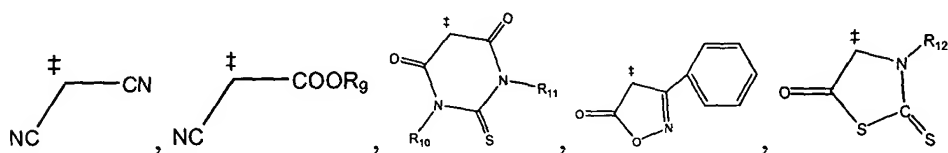
- wherein, in the both structures (ix) and (x),  $Rd_1$ - $Rd_4$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a  
 15        branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;  $R_2$  is selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

- 20        Structure (xi)



wherein  $R_7$ ,  $R_7'$ ,  $R_7''$ , and  $R_7'''$  represent each independently a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

wherein said Eacpt in said formula (v) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

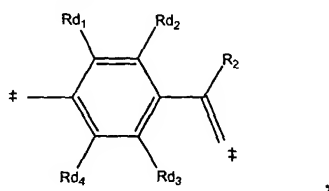
7. The composition of Claim 3,

wherein said B in said formula (vi) is a group selected from the group consisting of the structures (ix), (x) and (xi);

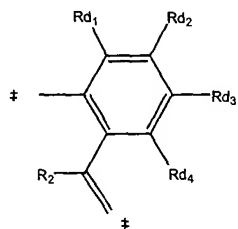
wherein the structures (ix), (x) and (xi) are:

15

Structure (ix)

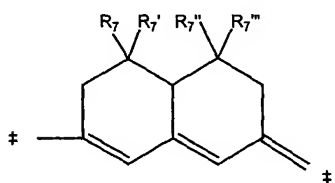


Structure (x)



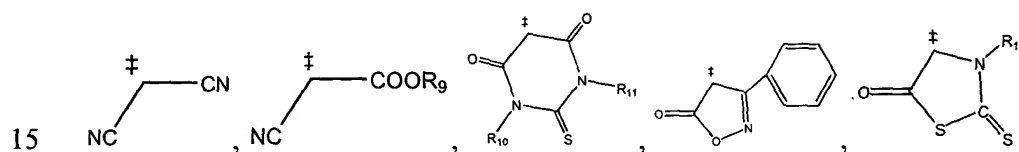
wherein, in the both structures (ix) and (x), Rd<sub>1</sub>-Rd<sub>4</sub> are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons; R<sub>2</sub> is selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

Structure (xi)



wherein R<sub>7</sub>, R<sub>7</sub>', R<sub>7</sub>'', and R<sub>7</sub>'''' represent each independently a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

wherein said Eacpt in said formula (vi) is an electron acceptor group represented by a structure selected from the group consisting of the structures;



wherein R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

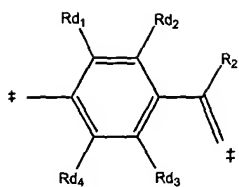
8. The composition of Claim 4,

wherein said B in said formula (vi) is a group selected from the group consisting of the structures (ix), (x) and (xi);

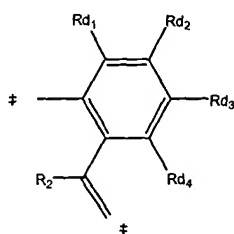
wherein the structures (ix), (x) and (xi) are:

Structure (ix)





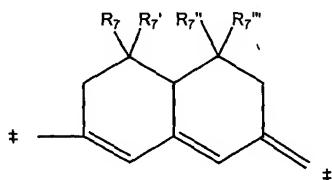
Structure (x)



wherein, in the both structures (ix) and (x), Rd<sub>1</sub>-Rd<sub>4</sub> are each independently selected  
 5 from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a  
 branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons; R<sub>2</sub> is  
 selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10  
 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10  
 carbons;

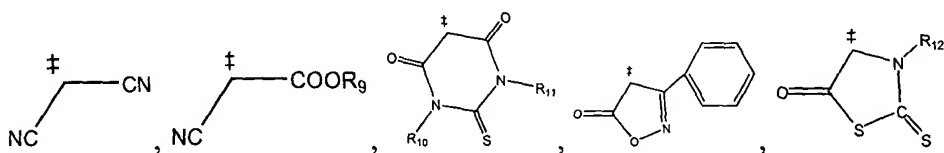
10

Structure (xi)



wherein R<sub>7</sub>, R<sub>7</sub>', R<sub>7</sub>'', and R<sub>7</sub>'''' represent each independently a hydrogen or a linear or  
 branched alkyl group with up to 10 carbons; and

15 wherein said Eacpt in said formula (vi) is an electron acceptor group represented by a  
 structure selected from the group consisting of the structures;



wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

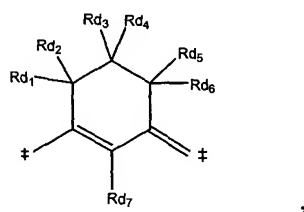
9. The composition of Claim 3,

5 wherein said Ar in said formula (vii) is an aromatic group selected from phenylene, naphthylene, or thiophenylene;

wherein said G in said formula (vii) is represented by a structure selected from the group consisting of the structures (xii) and (xiii);

wherein the structures (xii) and (xiii) are:

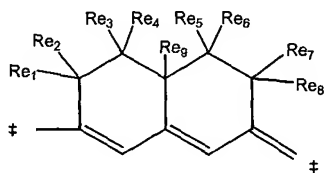
10 Structure (xii)



wherein,  $Rd_1$ - $Rd_7$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

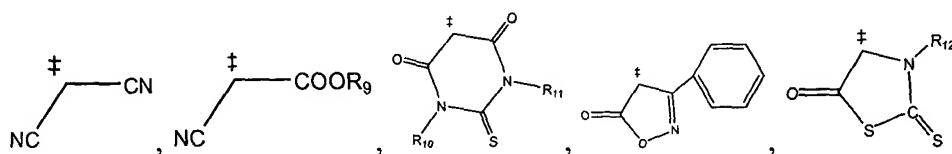
15

Structure (xiii)



wherein  $Re_1$ - $Re_9$  each independently represent a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

20 wherein said Eacpt in said formula (vii) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



wherein R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

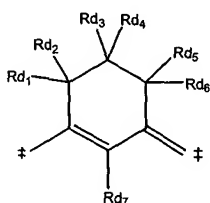
10. The composition of Claim 4,

5 wherein said Ar in said formula (vii) is an aromatic group selected from phenylene, naphthylene, or thiophenylene;

wherein said G in said formula (vii) is represented by a structure selected from the group consisting of the structures (xii) and (xiii);

wherein the structures (xii) and (xiii) are:

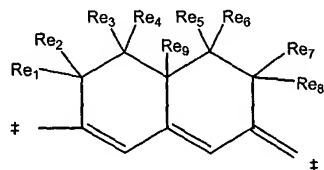
10 Structure (xii)



wherein, Rd<sub>1</sub>-Rd<sub>7</sub> are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

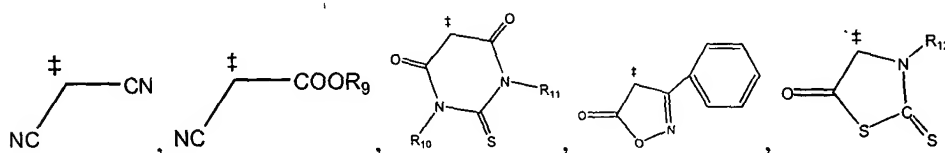
15

Structure (xiii)



wherein Re<sub>1</sub>-Re<sub>9</sub> each independently represent a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

20 wherein said Eacpt in said formula (vii) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

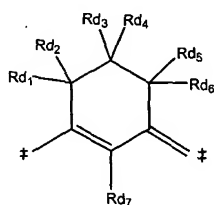
11. The composition of Claim 3,

5 wherein said Ar in said formula (viii) is an aromatic group selected from phenylene, naphthylene, and thiophenylene;

wherein said G in said formula (viii) is represented by a structure selected from the group consisting of the structures (xii) and (xiii);

wherein the structures (xii) and (xiii) are:

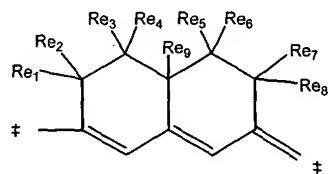
10 Structure (xii)



wherein,  $Rd_1$ - $Rd_7$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

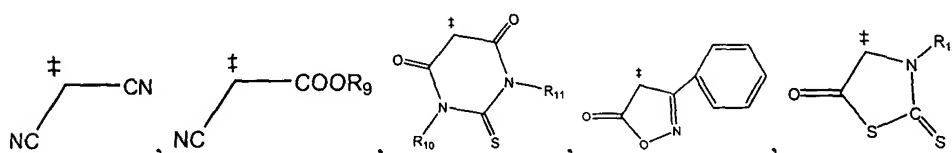
15

Structure (xiii)



wherein  $Re_1$ - $Re_9$  each independently represent a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

20 wherein said Eacpt in said formula (viii) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

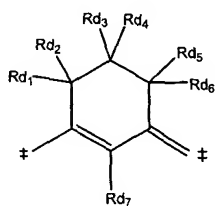
12. The composition of Claim 4,

5 wherein said Ar in said formula (viii) is an aromatic group selected from phenylene, naphthylene, and thiophenylene;

wherein said G in said formula (viii) is represented by a structure selected from the group consisting of the structures (xii) and (xiii);

wherein the structures (xii) and (xiii) are:

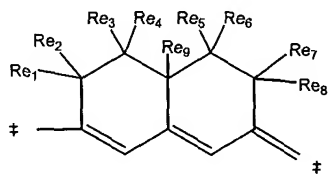
10 Structure (xii)



wherein,  $Rd_1$ - $Rd_7$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons;

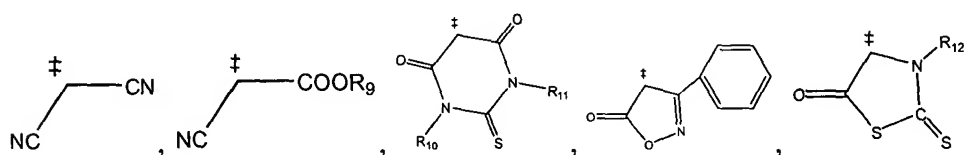
15

Structure (xiii)



wherein  $Re_1$ - $Re_9$  each independently represent a hydrogen or a linear or branched alkyl group with up to 10 carbons; and

20 wherein said Eacpt in said formula (viii) is an electron acceptor group represented by a structure selected from the group consisting of the following structures;



wherein  $R_9$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are each independently selected from the group consisting of a hydrogen atom, a linear alkyl group with up to 10 atoms, a branched alkyl group with up to 10 atoms, and an aromatic group with up to 10 carbons.

13. The composition of claim1, further comprising a plasticizer and a sensitizer.
- 5 14. The composition of claim2, further comprising a plasticizer and a sensitizer.
15. The composition of claim3, further comprising a plasticizer and a sensitizer.
16. The composition of claim4, further comprising a plasticizer and a sensitizer.
17. The composition of claim5, further comprising a plasticizer and a sensitizer.
18. The composition of claim6, further comprising a plasticizer and a sensitizer.
- 10 19. The composition of claim7, further comprising a plasticizer and a sensitizer.
20. The composition of claim8, further comprising a plasticizer and a sensitizer.
21. The composition of claim9, further comprising a plasticizer and a sensitizer.
22. The composition of claim10, further comprising a plasticizer and a sensitizer.
23. The composition of claim11, further comprising a plasticizer and a sensitizer.
- 15 24. The composition of claim12, further comprising a plasticizer and a sensitizer.